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| SUGHRUE MION, PLLC 2100 PENNSYLVANIA AVENUE, N.W. SUITE 800 WASHINGTON, DC 20037 | | | EXAMINER TADAYYON ESLAMI, TABASSOM | |
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Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary

Application No.

10/527,202

Applicant(s)

ITANO ET AL.

Examiner

Tabassom T. Tadayyon-Eslami

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 04 August 2003.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-18, 21 and 23 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-18, 21 and 23 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
 2. ☐ Certified copies of the priority documents have been received in Application No. _____.
 3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|---|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | 5) <input type="checkbox"/> Notice of Informal Patent Application |
| 3) <input checked="" type="checkbox"/> Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date <u>06/01/2007, 09/04/2007</u> . | 6) <input type="checkbox"/> Other: _____ |

DETAILED ACTION

Response to Amendment

The examiner note the amendments filed by the application on 04 September 2007. These amendments were filed in response to the office action sent on 02 May 2007, in which claims 1-22 were rejected.

The amendment modifies claims 1, 6-7, 11 18 and 21 and introduced new claim 23. Claims 12-17, 19-20 and 22 were cancelled.

Applicant's arguments with respect to claims 1, 6-7, 11, 18 and 20 have been considered but are moot in view of the new ground(s) of rejection.

Claim Rejections - 35 USC § 101

35 U.S.C. 101 reads as follows:

Whoever invents or discovers any new and useful process, machine, manufacture, or composition of matter, or any new and useful improvement thereof, may obtain a patent therefor, subject to the conditions and requirements of this title.

Claim Rejections - 35 USC § 112

The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

Claim 23 provides for the use of etching the high k films, but, since the claim does not set forth any steps involved in the method/process, it is unclear what method/process applicant is intending to encompass. A claim is indefinite where it merely recites a use without any active, positive steps delimiting how this use is actually practiced.

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Claim 23 is rejected under 35 U.S.C. 101 because the claimed recitation of a use, without setting forth any steps involved in the process, results in an improper definition of a process, i.e., results in a claim which is not a proper process claim under 35 U.S.C. 101. See for example *Ex parte Dunki*, 153 USPQ 678 (Bd. App. 1967) and *Clinical Products, Ltd. v. Brenner*, 255 F. Supp. 131, 149 USPQ 475 (D.D.C. 1966), also see MPEP 2173.05 (q).

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

Claims 1-5, 12-13, 15 and 23 are rejected under 35 U.S.C. 103(a) as being unpatentable over Rangarajan Jagannathan (US Patent Number: 6200891), here after Jagannathan.

Claims 1 and 23 are rejected. Claims 1 and 23 require an etching solution and a method of etching with the etching solution when the etching rate of high k material is 2 Å/min or greater and etch rate ratio of the oxide to the high k material is 50 or less. Jagannathan teaches a etching solution and a method for selective removal of oxides [column 2 line 65- column 3 line11], with a solvent comprising of HF (a fluoride-containing compound and an organic solvent, such

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as diglyme, for removing the oxides such as those commonly used in interlevel dielectrics [column 4 lines 15-233]. While Jagannathan does not explicitly teaches the etch rate and ratio of etch rate and relative dielectric constant properties, these properties are a result of the composition of the etching solution. It would have been obvious to have chosen 20-25% HF because it is within the range disclosed by Jagannathan, the claimed properties would obviously have been provided by the process disclosed by Jagannathan and to have omitted water because Jagannathan prefers water free solvents. *In re Best*, 195 USPQ 433, footnote 4 (CCPA 1977). Therefore, since Jagannathan teaches using the same materials (e.g. HF and diglyme) as applicant teaches in example 3 (table 1) in the etching solution in overlapping proportions (e.g. from 0.5 to 15 mol/liter of HF which would include 20-25% HF by weight) it is reasonable to presume that the etching solution of the said reference would inherently have the claimed properties of claims 1-5. The burden is upon the application to prove otherwise. *In re Fitzgerald*, 205 USPQ 594.

Jagannathan further teaches a removal solvent for dielectric materials comprises 0.5-15 molar of fluoride-containing compound and an organic solvent wherein said organic solvent is selected from the group consisting diglyme (claim1). For the solvent with 5 molar of hydrofluoric acid, with the density of diglyme equal to 0.937 gr/cm^3 , if we consider 1 liter of the solution ($937+100=1037 \text{ gr}$), and we have ($5 \times 20=100 \text{ gr}$ of HF in the solution). Therefore the % HF in the solution is $100/1037=\%10$ which is greater than %3. Also the %

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diglyme is $937/1037 = 90\%$, which is between 50-97% also the % water, is 0% which is less than 3%.

Jagannathan teaches using diglyme, $\text{CH}_3\text{-O- (CH}_2\text{CH}_2\text{-O)}_2\text{-CH}_3$, as the ether compound, therefore claims 1 and 23 are rejected.

Claim 2 is rejected. Jagannathan teaches an etching solution for selectively etching tantalum nitride (high k material $k \sim 100$) vs silicon dioxide [column 3 lines 2-11].

Claim 3 is rejected. Jagannathan teaches an etching solution for selectively etching hafnium oxide film [HfAlO , column 3 lines 2-11]

Claim 4 is rejected. Jagannathan teaches an etching solution for selectively etching aluminum alloy (high k, HfAlO) vs silicon dioxide [column 3 lines 2-11].

Claim 5 is rejected. Jagannathan teaches an etching solution which the etch rate for high k material is $2 \text{ }^\circ\text{A/ minutes}$ and the relative etching rate of the silicon dioxide film to the high k to is about 50 or less, therefore it is inherent that the etching rate of the silicon oxide film is $100 \text{ }^\circ\text{A/ min}$ or less.

Claim 12 is rejected. Jagannathan teaches an etching solution which meets the limitation of claim 11 and the ether compound has a relative dielectric constant of 30 or less [dielectric constant of diglyme is 7].

Claim 13 is rejected since Jagannathan discloses using gamma-butyrolactone as the organic solvent (claim 1).

Claim 15 is rejected since Jagannathan teaches the ether compound selected from the group consisting of diglyme [column 4 line 34].

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

Claims 16 and 14 are rejected under 35 U.S.C. 103(a) as being unpatentable over Rangarajan Jagannathan (US Patent Number: 6200891), here after Jagannathan in view of Zuel et. al. (US Patent number: 5120605) here after Zuel.

Claim 16 is rejected because although Jagannathan teaches the etching solvent comprising of hydrofluoric acid and an organic component, diglyme, an ether meets the limitation of claim 1 as discussed above, it does not teach using the specific all claimed ethers. However, Zuel teaches an etching solution for oxide surfaces comprising hydrofluoric acid and an ether, diethylene glycol diethyl ether and diethylene glycol monomethyl ether [column 4, line 39-42]. Therefore it would have been obvious to one of ordinary skill in the art at the time of invention was made to use the same solution as Jagannathan teaches (HF with the same ratio between the HF and the ether), and have the diethylene glycol monomethyl ether rather than diglyme as etching solution, because Zuel teaches this composition is suitable for etching oxides.

Claim 14 is rejected for the same reason claim 16 is rejected and because of the Diethylene glycol monomethyl ether has a hydroxyl group in the molecule.

Claim 17 is rejected under 35 U.S.C. 103(a) as being unpatentable over Rangarajan Jagannathan (US Patent Number: 6200891), here after Jagannathan and Paul D. Dodge (US Patent: 4469525), here after Dodge, Jagannathan teaches the etching solvent comprising of hydrofluoric acid and an organic component suitable for etching oxides materials. However it does not teach using acetates as a specific organic solvent. Dodge teaches an etching solution for etching oxides such as concrete (abstract) comprising strong mineral acids, such as HF (table 1), with solvents, such as cellosolve acetate, also known as ethylene glycol monoethyl ether acetate (Table 1, solution j). Therefore, it would have been obvious to one of ordinary skill in the art at the time of invention was made to have a solution that Jagannathan teaches which is comprises of HF and an organic solvent, and the organic solvent be cellosolve acetate because Dodges teaches that it is suitable solvent for strong mineral acid composition to etch the oxides.

Claim 18 is rejected under 35 U.S.C. 103(a) as being unpatentable over Rangarajan Jagannathan (US Patent Number: 6200891), here after Jagannathan and Klein et. al.(US Patent Number: 2003/0160026), here after Klein. Jagannathan teaches the etching solvent suitable for etching the oxides comprising of hydrofluoric acid and an organic component and it does not specifically teach specific ether. Klein teaches an etching medium comprising ethylene glycol monobutyl ether [claim10] and hydrofluoric acid [0048] for etching

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oxide surfaces. Therefore, it would have been obvious to one of ordinary skill in the art at the time of invention was made to have a solution comprising ethylene glycol monobutyl ether and hydrofluoric acid to obtain an etching solution for etching the oxides, because it is suitable for etching the oxides.

Claim 21 is rejected under 35 U.S.C. 103(a) as being unpatentable over Rangarajan Jagannathan (US Patent Number: 6200891), here after Rangarajan and Christenson et. al. (US Patent: 2003/0235985) here after Christenson.

Jagannathan teaches,

An etching solution comprising hydrofluoric acid and organic solvent for etching the oxides and meet the limitation of claim 1 as discussed above. He does not teach the method for etching the silicon oxide, high k film and the gate electrode. However, Christenson teaches,

A process for etching high dielectric constant films more rapidly than coexisting SiO₂, polysilicon, silicon and/or other films [abstract] comprising a solvent with at least one fluoride species [claim 30]. Christenson further teaches the method for selectively etching the high k dielectric (higher than 8, such as HfSiO) films with respect to silicon dioxide and a gate electrode [0027] comprising at least one fluorine ion, such as commonly used concentrations of HF [0032, 0020].

Therefore, it would have been obvious to one of ordinary skill in the art at the time of invention was made to have a method to produce the same structure than applicant claimed by the method in which Christenson used, etching solvent comprising HF and an organic solvent, because the resulting structure seems to

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be identical with applicant etched article. The etched structure that obtained with the above method of is identical with what applicant has obtained.

Response to Argument

Applicant's arguments filed on Sept. 4, 2007 have been fully considered but they are not persuasive. The applicant argue the etching rate of the etching solution teaches by Jagannathan does not teach the etching rate of 2 A/ min. However, since the etching solution has hydrogen fluoride and specific ether compound (dyglyme) and further comprises 3% of mass or more fluorine compound, 50-97% of mass or more ether compound, therefore it has of have the property of etching with the etching rate of 2 A/ min. Jagannathan teaches an etching solution contains about 5 molar of fluoride containing compound and an organic solvent to selectively remove the dielectric oxide [column 2 lines 30-32]. He further teaches the fluoride containing compound is HF [column 3 line 26] and the organic solvent is diglyme [column 4 line 33], which is ether. Therefore it is clear that a solution with molarity of 5 for HF in diglyme, has 20-25% HF by weight which is more than 3% claimed HF and 80-75% of ether which is in the claimed range for ether compound and %0 of water (less than %3). Therefore, Jagannathan teaches a solvent which is in the range of claimed by the applicant and therefore claim 1 is not patentable. In response to applicant's argument that Jagannathan does not allow predictability of selective to HF silicate, the fact that applicant has recognized another advantage which would flow naturally from following the suggestion of the prior art cannot be the basis for patentability when

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the differences would otherwise be obvious. See *Ex parte Obiaya*, 227 USPQ 58, 60 (Bd. Pat. App. & Inter. 1985). The argument is unconvincing because Jagannathan recognizes that its solutions have advantageous selective etching properties. Jagannathan also teaches the etching solution for etching high k films like tantalum nitride [column 3 line 8].

Applicant argues that neither Zuel nor Dodge teaches the claimed concentration ranges. The argument is unconvincing because Zuel and Dodge are merely relied upon for showing of suitable solvents for HF etchant compositions. Jagannathan teaches operative concentration ranges.

In response to applicant's arguments against the references individually, one cannot show nonobviousness by attacking references individually where the rejections are based on combinations of references. See *In re Keller*, 642 F.2d 413, 208 USPQ 871 (CCPA 1981); *In re Merck & Co.*, 800 F.2d 1091, 231 USPQ 375 (Fed. Cir. 1986).

Conclusion

Applicant amendment necessitated the new ground (s) of rejection presented in this office action Accordingly, **THIS ACTION IS MADE FINAL**. Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).


A shortened statutory period for reply to this final action is set to expire **THREE MONTHS** from the mailing date of this action. In the event a first reply is

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filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Tabassom T. Tadayyon-Eslami whose telephone number is 571-270-1885. The examiner can normally be reached on 7:30-5.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Michael Cleveland can be reached on 571-272-1418. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.



MICHAEL B. CLEVELAND
SUPERVISORY PATENT EXAMINER

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Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

T.T



MICHAEL B. CLEVELAND
SUPERVISORY PATENT EXAMINER